Leaf Spring:

Laminated Spring, Locomotive Spring.

Truck Spring.

Master leaf length $= 2L + \pi (d+t)^2$.

$$n = n_f + n_g$$

$$2L = 2L_1 - b$$

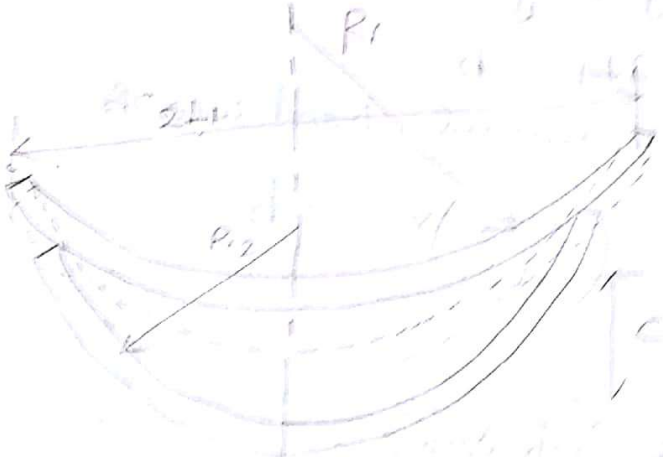
b - Central band width

$$l_1 = \left(\frac{2L}{n-1}\right) \times 1 + b.$$

Nipping of Leaf Spring

The stress in the full length leaves of 50% greater than graduated ~~than~~ graduated leaves in order to utilize the material is a best advantage all leaves are in equally stressed. This may be achieved by pre-stressing in the leaves. The pre-stressing of the spring can be done by giving greater radius of curvature to the full length leaves than the graduated leaves before assembly. Initial gap (C) between full length leaves and graduated leaves before assembly is called nip. When the central bolt holding leaves together is extra full length leaves will

and having an initial stress in the direction opposition that of normal load. Graduated leaf will have an initial stress in the same direction as that of normal load.



1. A truck spring has 12 number of leaves. Two of which are full length leaves. The spring supports 1.05 m apart. Central band is 85 mm wide. Ratio of total depth to the width of the spring is 3. The central load is given as 5.4 kN. The permissible stress is 220 MPa. Determine i) Thickness and width of the steel spring leaves and ii) Deflection of the spring iii) Length of each leaves.

Given:-

$2P = 5.4\ kN$

$2L_1 = 1050\ mm$

$B = 85\ mm$.

$\frac{nt}{wb} = 3$

$\sigma_b = 280\ MPa$

Solution:

$2L = 2L_1 - B$

$= 1050 - 85$

$= 965\ mm$.

$L = 482.5\ mm$

$2P = 5.4\ kN$

$P = 2.7\ kN$

$n_g = 10$

$n_f = 2$

$n = 12$

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$\sigma_b = \frac{6PL}{wnt^2}$

$\sigma_b = \frac{6PL}{n \times \frac{nt}{3} \times t^2}$

$= \frac{18PL}{n^2 t^3}$

$$280 = \frac{18 \times 2.7 \times 10^3 \times 482.5}{(12)^2 t^3}$$

$$t^3 = 581.5$$

$$t = 8.34 \text{ mm}$$

$$b = \frac{n \times t}{3}$$

$$= \frac{12 \times 8.34}{3}$$

$$b = 33.3 \text{ mm}$$

Deflection

$$Y = \frac{12 P L^3}{b t^3 E (3n_e + 2n_g)}$$

$$= \frac{12 \times 2.7 \times 10^3 \times (482.5)^3}{210 \times 10^9 \times 33.3 \times 581.5 \times (3 \times 2 + 2 \times 10)}$$

$$= \frac{15633090}{5034621} = \frac{3.63 \times 10^{12}}{1.057 \times 10^{11}}$$

$$Y = 34 \text{ mm}$$

$$l_1 = \left(\frac{2L}{n-1}\right) \times 1 + b_{band}$$

$$= \frac{965}{11} + 85$$

$$= 172.72 \text{ mm}$$

$$l_2 = \frac{965}{12-1} \times 2 + 85$$

Band

$$= 260.4 \text{ mm}$$

$$l_3 = \frac{965}{12-1} \times 3 + 85$$

$$= 348.18 \text{ mm}$$

$$l_4 = 435.88$$

$$l_5 = 523.6$$

$$l_6 = 611.32$$

$$l_7 = 699.04$$

$$l_8 = 786.76$$

$$l_9 = 874.48$$

$$l_{10} = 962.2$$

$$l_{11} = 1049.92$$

$$l_m = 2l_1 + \pi(d+t)^2$$

$$= 2 \times 525 + 2\pi(17 + 8.34)^2$$

$$= 1209.6 \text{ mm}$$

1. A locomotive spring has a overall load on length of 1.1 m and sustain a load of 75 kN at the centre. The spring has extra 3 full length leaves and 15 graduated leaves with central band 100 mm wide. All leaves are equally stressed to 420 N/mm² when fully loaded. Ratio of total spring depth to width ratio is approximately is 2

Modulus of rigidity $= 2.1 \times 10^5 \ N/mm^2$.
Determine i) Widths and thickness of leaves ii) Lengths of each leaves iii) Initial space that should be provide btwn full length & graduated leaves before band load is applied iv) The load exerted on spring is assembled.

Given :-

$E = 2.1 \times 10^5 \ N/mm^2$

$2P = 75 \ kN$
$= 37.5 \ kN$

$2L = 1100 \ mm$

$n_f = 3$, $n_g = 15$

$n = 18$

$\omega = 100 \ mm$.

$\sigma = 420 \ N/mm^2$

$\frac{nt}{b} = 2$.

Solution :-

$$C = \frac{2PL^3}{Enbt^3}$$

Preload $P_i = \frac{P n_g n_f}{n(1.5 n_f + n_g)}$

$2L = 2L - 100$
$= 1000 \ mm$

$$\sigma_b = \frac{12PL}{n^2 t^3}$$

$$420 = \frac{12 \times 37.5 \times 500 \times 10^3}{18^2 \times t^3}$$

$t^3 = 1653.$

$t = 11.82 \text{ mm}$

$b = \frac{n \times t}{2}$

$= \frac{18 \times 11.82}{2}$

$b = 106.42 \text{ mm}.$

$l_1 = \frac{2L}{(n-1)} \times 1 + W$

$= \frac{1000}{17} \times 1 + 100$

$= 158.82 \text{ mm}$

$l_2 = 217.64 \text{ mm}$

$l_3 = 276.46 \text{ mm}$

$l_4 = 335.28 \text{ mm}$

$l_5 =$

$l_6 =$

$l_7 =$

$l_8 =$

$l_9 =$

$l_{10} =$

$l_{11} =$

$l_{12} =$

$l_{13} =$

$l_{14} =$

$l_{15} =$

$l_{16} =$

$l_{17} =$